SYSTEMS FOR SUCKLING COWS BREEDING IN MOUNTAIN AREAS OF CENTRE ITALY

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ABSTRACT

A research was carried out to identify the most suitable techniques of suckling cows housing in a mountain area of centre Italy (Tuscany Apennine), rich in meadows and pastures. Livestock breeding has represented a basic economical resource for people living in this area since the sixties.

The livestock breeding situation in the region was analysed referring to Chianina and Garfagnina breeds. Chianina is the most widespread breed in Tuscany, placed all over the country areas of the region. Pasturage in mountain areas is becoming more and more interesting for the breeding of this race, characterized by a high productivity. On the contrary Garfagnina is a more rustic but less productive breed, with a great risk of extinction because of changes in the economy of the countryside where it was historically bred.

The existing housing solutions for Chianina and Garfagnina beef-cattle in Tuscany were investigated. Trials were conducted in particular in a farm housing 50 Garfagnina cows, in order to study the space allowance, the suckling cow behaviour patterns and to verify the breeding effects on their welfare conditions. This study was carried out in January, period in which the cattle-shed is more used by animals because of cold weather conditions. During the good season, cows are at the nearby pasture, without any refuge. Behavioural analysis was performed on tied and free cows by a television equipment consisting in a closed circuit TV, a time-lapse videotape, television cameras and infrared lamps. Day-time activities (from 7 a.m. to 5 p.m.) were recorded in the different housing solutions. Tied suckling cows spend most of their time standing or feeding. The resting period is very short (12,8% of the diurnal time) and the interactions between the animals (licking, grooming, nibbling) are very frequent. This research confirms that Garfagnina cows are very rustic animals, suitable for an extensive breeding which use the house only during winter periods. Simple shelters for feeding during the winter season could be adequate.

The breeding in a sustainable way of suckling cows such as very rustic ones (Garfagnina) or more productive ones (Chianina) can be considered a good resource in marginal mountain areas. Low environmental impact housing solutions have to be designed, using local building materials (like timber) and adopting alternative housing systems. Some examples are given in this paper.

KEY-WORDS: Suckling cows, behaviours, housing solutions, extensive livestock keeping, sustainable breeding.

INTRODUCTION

In Tuscany cattle is bred both grazing and in cattle-sheds. Outdoor livestock breeding is wide spreading in Tuscany, above all in fringe areas such as Apennine Mountain. In these regions it represents an important economic resource, which creates working opportunities for local people.

This is linked to the growing interest for biological products, as well as for environmental aspects and animal welfare. Outdoor breeding does not mean going back to old breeding systems, but it involves the effort of creating a productive and sustainable system for environment and for man itself.

Different housing solutions in Tuscany, relative to Chianina and Garfagnina cows, were analysed by the Department of Agricultural and Forestry Engineering of Florence.

Chianina is the more widespread race in Tuscany region, amounting to 18.000 head (ANABIC, 2002). The Chianina is typical of Centre Italy, well-known and appreciated ever since the past; it is characterized by a great somatic development causing the appellation of "giant" beef-cattle. Today it is a breed specialized in the production of beef.

Garfagnina is spread in Garfagnana region. Garfagnina cows are very rustic animals, very resistant against winter hard weather conditions, but at the same time able to exploit the low productivity pastures of the country.

Data about the number of farms and the different housing solutions adopted in the region were collected. The aim of the project is to identify and to value different ways of projecting and realizing an outdoor and sustainable beef-cattle breeding in mountain areas. New design criteria are defined, which are turned towards specific housing solutions for beef-cattle bred on pasturage. Building solutions for an outdoor livestock breeding are shown, in order to obtain good welfare and sanitary conditions for the animals, and to exploit economically the resource of fringe areas.

MATERIALS AND METHODS

Farms survey

During the contacts with corporations, associations, mountain communities and breeders taken in the chosen area, a complete inventory of farms in Tuscany with Chianina and Garfagnina cows was drawn up.

The investigation hold on Chianina cows concerned all the Tuscany region. Data were collected by the National Association of Italian Beef-Cattle Breeders (ANABIC) and 56 farms were individuated in the different provinces of the region. On the contrary by the survey hold on Garfagnina cows, 43 beef-cattle farms were found in Garfagnana and Serchio Valley. No more than 18 farms bred only Garfagnina cows; in the others 25 farms some Garfagnina cows are present as isolated subjects or as cross-breeds. By the survey several details were collected about the different housing solutions diffused in the region.

In order to value the functionality of different housing solutions, a farm was chosen in Garfagnana area for behavioural analysis and then to collect indications about animal welfare conditions. Animals are kept either in the loose housing or at the tying stalls. The animal activities were recorded by television equipment. All around the cattle-shed are lands and pastures.

Tying stall house

The examined house for Garfagnina cows has a two pitch roof with an open ridge for ventilation, a feeding alley and an inspection alley behind the stalls. A manure gutter collects urine and dung which are pushed away by a conveyors belt with blades (with alternative motion). The tying stalls are 1,20 m in width and 1,70 m in length (without considering the manure gutter). The manger is 0.70 m high (from the floor). During the trial 22 suckling cows were kept at the tying stalls. Behavioural trials were conducted on 3 suckling cows (A, B and C) during the month of January. Data were collected in the daily period from 7 a.m. to 5 p.m.

Loose house

Behavioural trials were conducted on 28 Garfagnina cows, varying in age and physiological phase (no suckling ones are present), lodged in a loose housing with deep litter on concrete floor, having an access to pastures. The inside area is about 80 m^2. This is quite an extensive way of livestock keeping: animals can use the loose housing, come in and go out as they prefer; feed is provided in the morning and in the evening. The daily hours interested by the behavioural analysis are from 7 a.m. to 5 p.m. too.

RESULTS AND DISCUSSION

Farms survey: structural data

Chianina housing

With regard to the survey of Chianina farms, the data collected show the presence of 56 farms in Tuscany. These farms are principally concentrated in the provinces of Siena (37%) and Livorno (26%); other ones are located in the province of Pisa (12%), Arezzo, Grosseto (9% in both cases) and Firenze (7%). The farms are often of little size with 50-100 head (30% of the cases) or very little size. In this case they have less than 50 animals and they represent the 47% of the total number. Bigger farms that count from 100 to 300 livestock head constitute only the 19% of the total. Farms with more than 300 head are only the 4% in Tuscany. With regard to the adopted housing solutions data show that cattle is kept in the loose housing very often (73% of the farms), while in 23% of the cases the cows are kept at the tying stalls. Only 4% of the animals are reared always on pasture.

When considering only livestock farms with pasture, in 82% of the cases cattle is kept in loose housing, while only a 6% of the farms keep the animals at the tying stall. In 12% of the cases cattle is reared always on the pasture without any shed.

Tying stall dimensions were also analysed. Generally the tying stall is 2,30 m (± 0,22) in length, 1,14 m (± 0,12) in width; the manger is 0,63 m (± 0,13) deep. The single cow area at tying stall is about 2,64 m^2 (± 0,03). Almost all of the loose houses (99%) have self-locking barriers. In this kind of housing solution animals have about 5,5 m^2 (± 0,03) of covered area per head. The CE directive 1804/99 prescribes almost 4,5 m^2 of covered area for single head of beef-cattle (with a body weight of 350 kg). Therefore Chianina loose houses seem not to be suitably dimensioned for the animals.

Garfagnina Housing

In the examined area 43 farms with Garfagnina cows are present. Most of them raise different breeds; only in 18 farms pure Garfagnina cows are bred. Most of the animals are reared in a semi-wild state but with free access to the cattle-shed during the winter period.

The final fattening period is realized mainly inside the building, in order to obtain good microclimatic conditions for the animals and a favourable feed conversion index. Cattle-sheds are very often old buildings, rearranged for hosting animals inside. Cows kept into loose housing lye down on concrete floor covered with straw or chestnut-tree leaves. Cattle-sheds have bad natural lighting conditions and ventilation is obtained by doors and windows manually operated by the farmer. The ventilation chimney is almost always absent. In most of the cases a conveyor belt with blades or a front loader with scraper blade carries out the manure which is conveyed and accumulated on a dung platform. Some breeders rear beef-cattle in the wild state, but in this case a rich integrative feeding system is necessary especially during the winter period.

Behavioural Analysis

Tying Stall House

In the following figures the main results obtained during the experimental trial with Garfagnina cows are shown. In figure 1 the behaviours observed during two days (from 7 a.m. to 5 p.m.) for 3 suckling cows (A, B, C) kept in the tying stalls are reported. The 3 cows are in lactation: twice a day they suckle their calves while being fed.

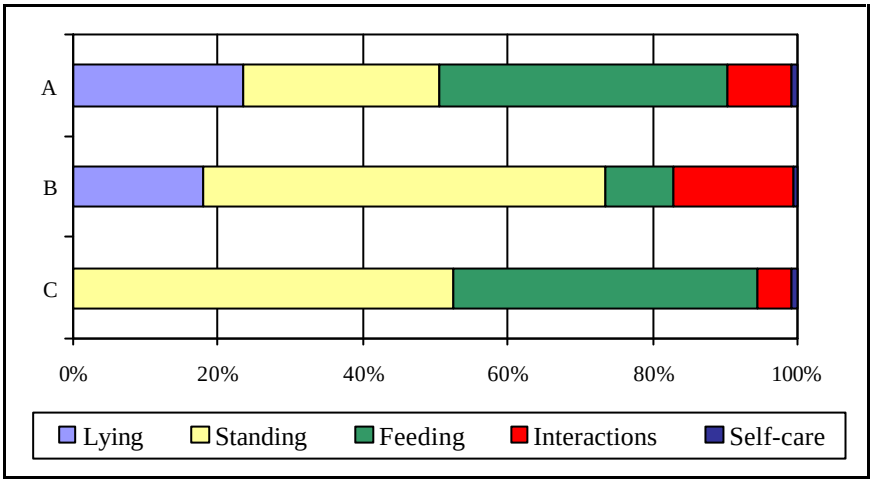


Fig. 1: The 3 suckling cows main activities at the tying stall (7 a.m. ¸ 5 p.m.)

Daily activities were divided into lying, feeding, and standing. "Interactions" are considered all the moments of contact (licking, biting, grooming and scratching) that a cow has with its neighbours. "Self-care" includes all the cleaning activities of a cow (licks above all).

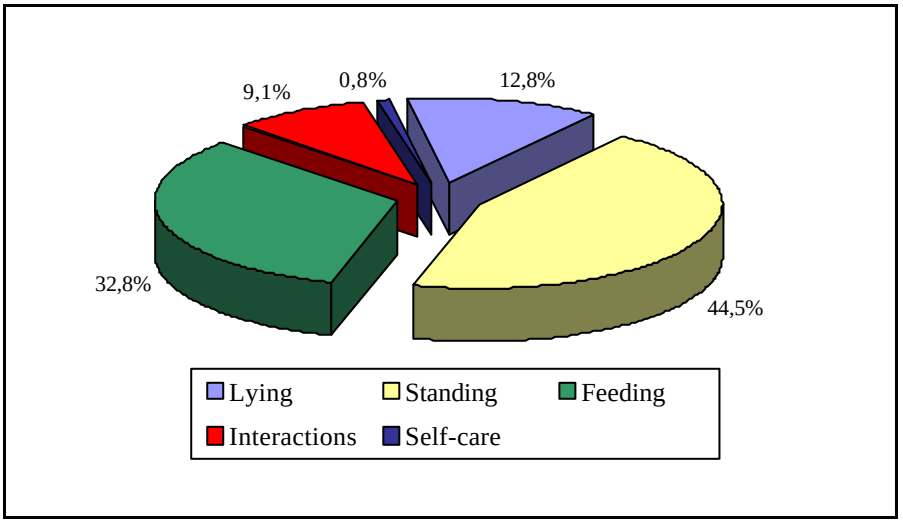


Fig. 2: Behaviour of the cows kept at the tying stall (mean value of the 3 cows).

In figure 2 the same activities of cows A, B, C during all the day are shown like mean values.

From figure 1 and 2 it is to be noticed that cow C never lies down during the observed period. In fact the resting time is only 12,8% of the total and the cow spends most of its time in standing activity (44,5% of the total). The tying stalls are planned as the long ones (there is a high manger and the animal, kept at the stall by tie, has some freedom of movement). Actually the stalls are under-dimensioned in length for Garfagnina cows and make the movements very difficult for the animals: they lie down and rise up laboriously. This aspect is increased by the insufficient presence of straw, that makes the floor slippery. These reasons can induce the suckling cows to lie down

rarely, having a preference for resting when feed availability is scarce (e.g. during the night). In fact feeding is distributed in the morning and in the evening; the animals eat *ad libitum* immediately after its distribution. Time for feeding takes about the 33% of the total time observed. Interactions among the cows are as well very important (9% of the total time).

In table 1 the lying times for the same 3 cows (A, B, C) kept at the tying stalls in a day are shown. The number of events which last less than 10 minutes, from 10 to 30 minutes, from 30 to 60 minutes and longest ones (periods during which the animal remains in a lie down position more than 60 minutes) are recorded. This table points out that events of a cow lying during the day are very few. On the contrary it is shown that periods where the animals remain in a lie down position more than 60 minutes are prevailing. This could be due to the difficulty in rising up and lying down in the tying stalls. Table 1 seems to confirm the low lying time values shown in figure 1 and 2 This point of view can be confirmed by the scientific literature: several studies have shown that cows restricted at the tying stalls are more reluctant to change position from lying to standing: they lay down less frequently, but for long periods (till 10,4 hours a day), suggesting that they are reluctant to perform the process of standing and lying (Cook, 2002). Moreover some authors (Miller and Wood-Gush, 1991; Krohn *et al.*, 1992) consider the total time spent lying a day as an important indicator of cow comfort; a minimum average lying time of 576 min/day for cubicles has been suggested (Wierenga and Hopster, 1990). The A cow, which spends the highest value of lying time, lays down about 350 min/day only during the daily hours. Anyway, for none of the Garfagnina cows good welfare conditions seems to be reached.

Tab. 1: Number and duration of the 3 cows' lying events.

Cow lying times at the tying stalls.									
	<10 min.	N. of Events	10-30 min	N. of events	30-60 min	N. of events	>60 min	N. of events	Total time (min)
A	0.02.49	1	0.29.23	1	0.52.50	2	1.42.26	2	5.42.44
B	0.07.00	1	0	0	0.33.01	1	1.21.41	2	3.23.22
C	0	0	0	0	0	0	0	0	0

Loose House

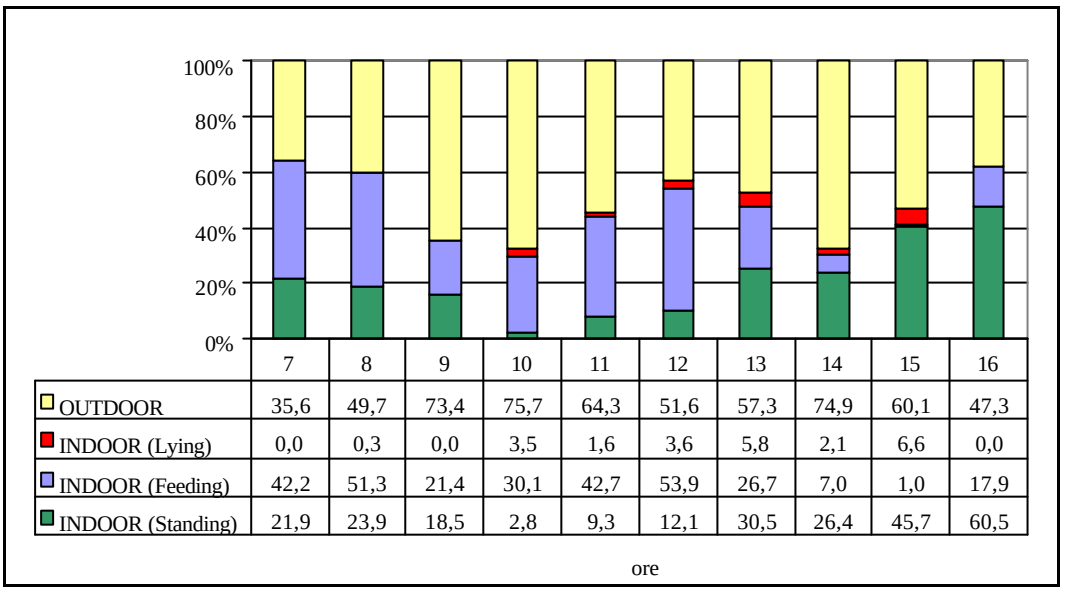
In figure 3 the behaviour of Garfagnina cows reared in a semi-wild state (28 heads) is represented. The graph shows the percentage of utilization of the indoor area by cows during the day (from 7 a.m. to 5 p.m.) and the animal activities. The time the cows spend outside and inside the loose house is shown. The latter is divided into different activities like feeding, lying and standing. The graph analysis shows that the indoor area is occupied by animals mainly in the morning (from 7 to 8 a.m.) and in the evening (from 4 to 5 a.m.) when the feed is provided. During these hours about the 60% of all cows are inside. During the central hours of the day cows remain outside the cattle-shed. When animals are inside, they spend most of their time standing (25%) and lay down with difficulty (2,3%). During the recorded daily period, 30% of the cows on average come inside for feeding. The indoor area seems to be used by cows mainly for feeding and as a nocturnal shelter (from 5 p.m.). These data refer to the winter period, when the daylight is very short.

The loose housing is not suitably divided into rational spaces because of the high number of animals in the area. In fact, considering its surface (80 m^2), there is about 2,8 m^2 of covered area for each cow only. The insufficient indoor area could be the reason for the low lying times observed. Irish researchers explain that in a group of cows housed with high density, lying times are reduced because they imply inconveniences for the animals, like food lesions (Cook, 2002).

Moreover the low attendance in the resting area inside the cattle-shed during the winter period attests the rusticity of the breed: animals prefer to pasture outdoor also with cold weather

conditions. Inside the cattle-shed, the presence of standing animals which do not reach the manger during the distribution of forage reveals an under-dimensioned front of feeding. Besides, the dominant subjects cause inconvenience to the other animals, sending them away from the manger. This behaviour can be due to managerial aspects of the breeding (the animals are hungry) and a solution could be the adoption of a self-locking feed joke.

Observations performed on animal cleaning show that the quantity of straw in the indoor area is not enough for a right management of the deep bedding. The animals are very dirty. Some authors indicate the cleanliness as a key indicator of welfare (Fragonesi and Leaver, 2001). In fact for dairy cows the cost of poor hygiene is a great risk of mastitis and lameness. The lack of straw is typical in mountain areas.



	7	8	9	10	11	12	13	14	15	16
OUTDOOR	35,6	49,7	73,4	75,7	64,3	51,6	57,3	74,9	60,1	47,3
INDOOR (Lying)	0,0	0,3	0,0	3,5	1,6	3,6	5,8	2,1	6,6	0,0
INDOOR (Feeding)	42,2	51,3	21,4	30,1	42,7	53,9	26,7	7,0	1,0	17,9
INDOOR (Standing)	21,9	23,9	18,5	2,8	9,3	12,1	30,5	26,4	45,7	60,5

Fig. 3: Percentage of utilization of indoor area and activities of the animals.

Management Times

The time taken by the farmer for feeding and cleaning animals kept in the different housing solutions (loose hosing and tying stalls) is shown in figures 4 and 5. In the graphs the time is calculated in seconds, as value/day/head. The time spent by the breeders to clean cows is also considered. The figures show how the management time required in the two examined housing solutions is different. In fact the time required to feed the animals at the tying stalls is shorter than the one required to feed the cows in the loose housing. The time required to unroll bales of hay by the tractor in the feeding alley and the time required for its distribution with the fork by the farmer are considered as well as the time to feed the cattle in the loose housing solution. This explains the high values of “the time for cattle feeding in the loose housing”. The cows at the tying stall are fed by a manual distribution of floury feed and hay. On the contrary the daily cleaning time per head is higher for the cattle at the tying stall in comparison with the one in loose area. The time to keep cattle clean in loose area is just the one required by the farmer to pass along the feeding alley and to distribute a certain quantity of straw. The calculated time does not consider the removal of the deep bedding at the end of the cycle. Manure is swept away from the tying stall in the liquid manure gutter, where a conveyors belt with blades pushes away and accumulates it on a dung platform.

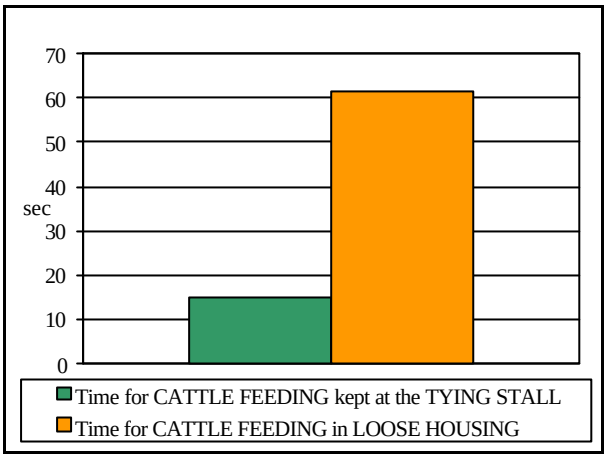


Fig. 4: Comparison of the feeding time between cattle kept at the tying stall and in the loose housing (value in sec/day/head).

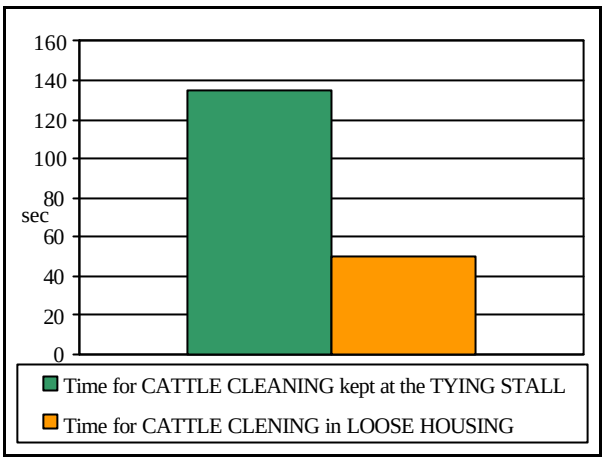


Fig. 5: Comparison of cleaning time between cattle kept at the tying stall and in the loose housing (value in sec/day/head).

Designing cattle-sheds for suckling cows breeding

On the basis of the data obtained from the survey and thanks to the behavioural analysis conducted on the animals, some criteria for designing buildings for cattle breeding were defined. Loose housing is clearly to be preferred to tying stalls.

Some loose housing solutions characterized by innovatory building elements have been developed.

The shelters are designed making an allowance for supporting elements in round timber, in order to increase the value of local forestry productions, to reduce building costs and to meet the requirements of a good environmental impact. Owing to the shortage of straw in mountain areas, farmers have to reduce the quantity of straw required for a satisfactory management.

Figure 6 shows the plant of a loose house with deep bedding in resting area; its section is detailed in figure 7. In figure 8 and 9 the plant and the section of a loose house with a sloped floor and straw bedding in resting area are shown. For the latter solution a representation 3-D is also proposed (fig. 10 and 11).

CONCLUSIONS

The analysis of the existing cattle farms in Apennine areas of Centre Italy shows the wide spreading of the extensive livestock farming, especially for suckling cows.

The results of the survey about Chianina and Garfagnina breeding show a quite obsolete situation in the region. The cattle-sheds are always old, obtained from rebuilt houses, realized with simple projects and not very suitable for the animals. In most of cases animals are kept at the tying stalls, often badly dimensioned. In addition the loose houses are not well divided into rational spaces: animals are always kept in pens with the floor covered with litter, but without a separated feeding area. This solution needs a great quantity of straw to keep the pen clean. In the analysed farms the use of straw is very poor so animals are very dirty. In fact animals are often kept in bad hygienic conditions. The wide pasturages available outside the cattle-sheds can partially alleviate the negative aspects shown. In general the cattle-sheds, used mainly in winter periods, are characterized by low investments, because farms are oriented to a low cost management. These considerations are valuable both for a rustic breed (like Garfagnina) and for a more productive one (like Chianina).

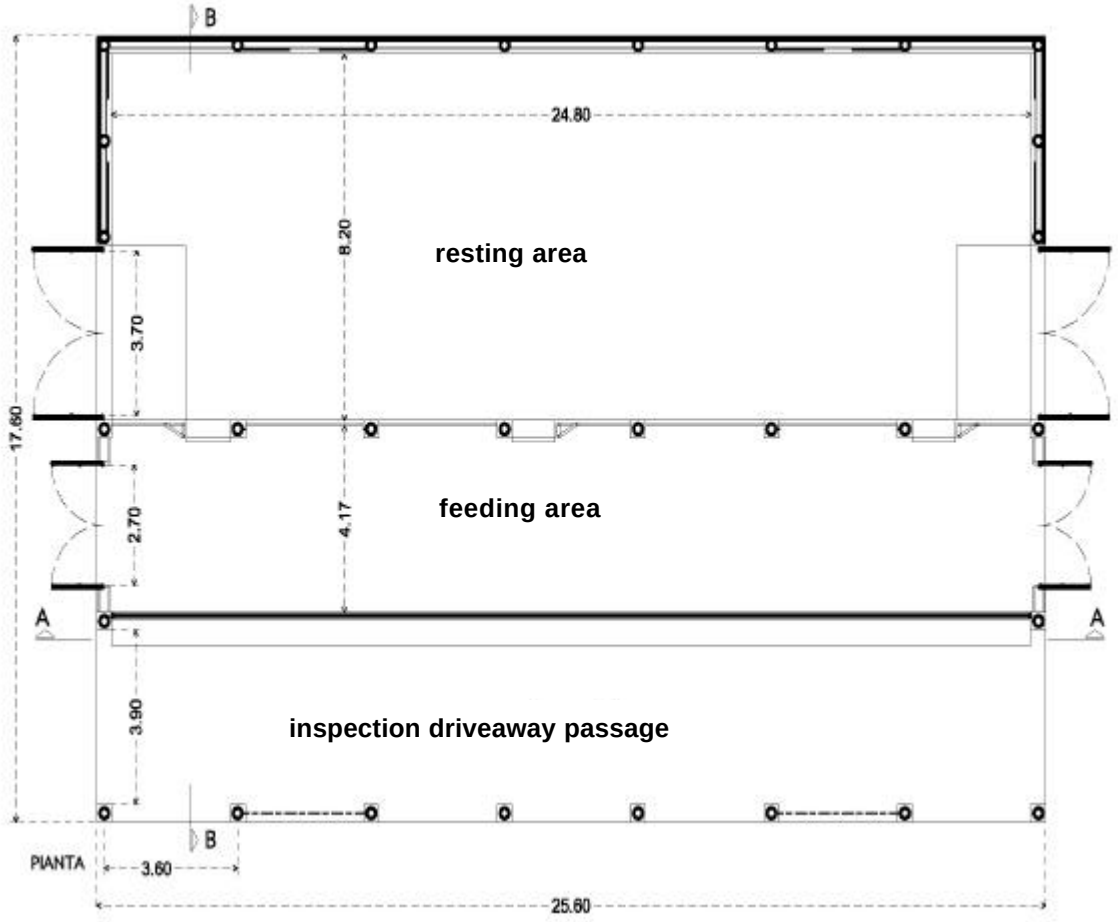


Fig. 6: Plant of the a deep litter loose housing.

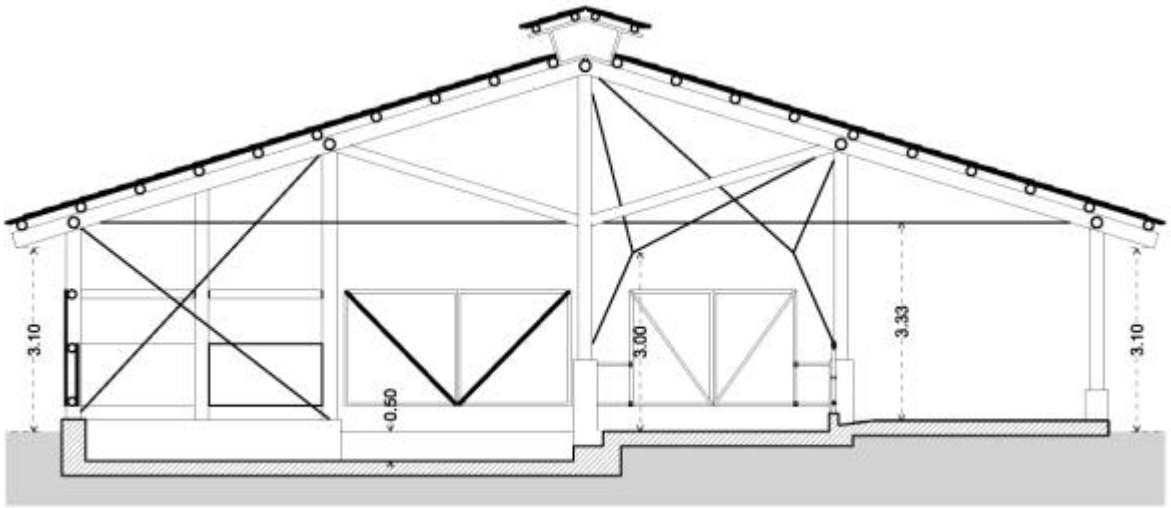


Fig. 7: Section of a deep litter loose housing.

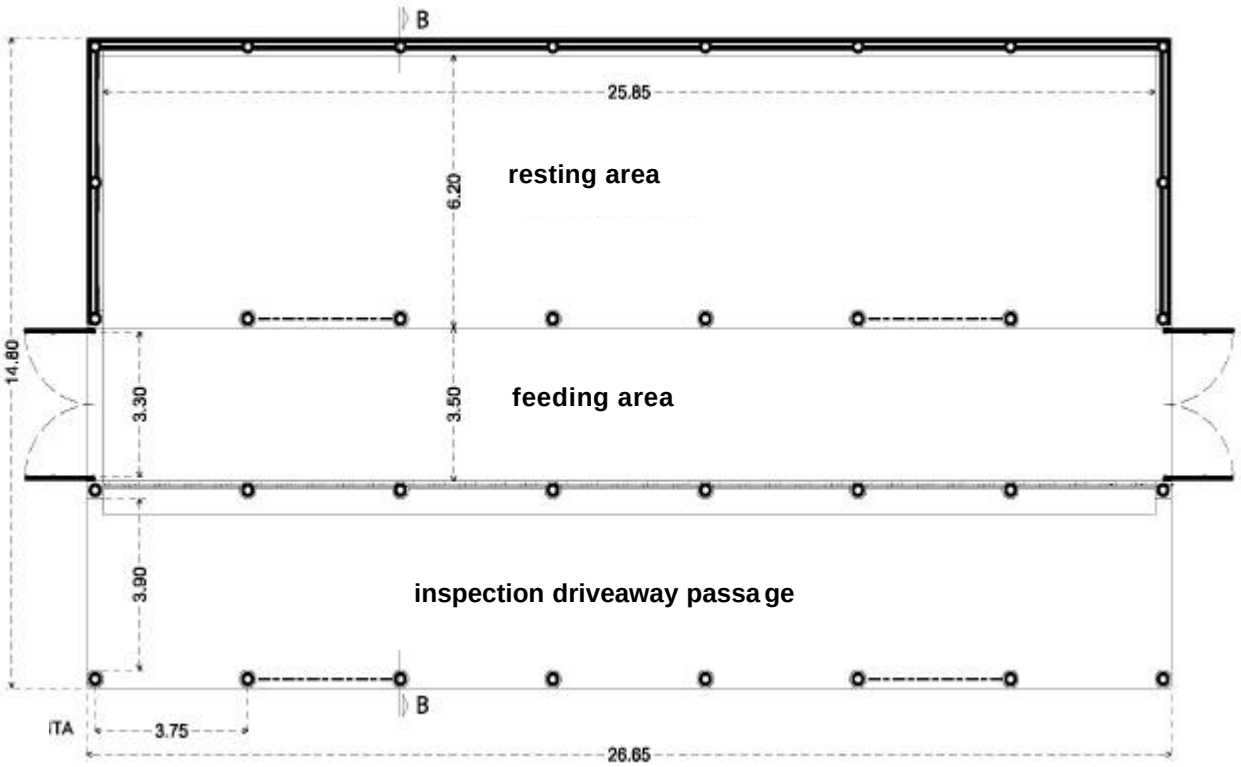


Fig. 8: Plant of a sloped floor loose housing.

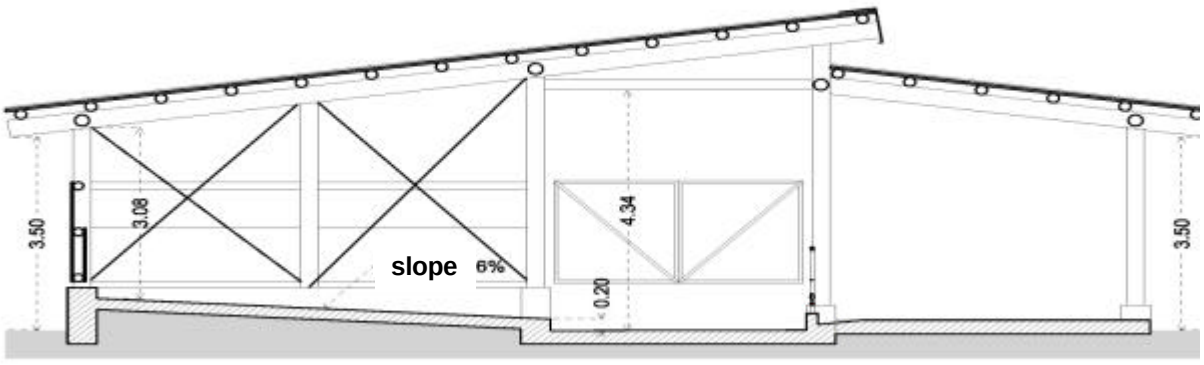


Fig. 9: Section of a sloped floor loose housing.

Fig. 10: The sloped floor loose housing: a 3-D representation.

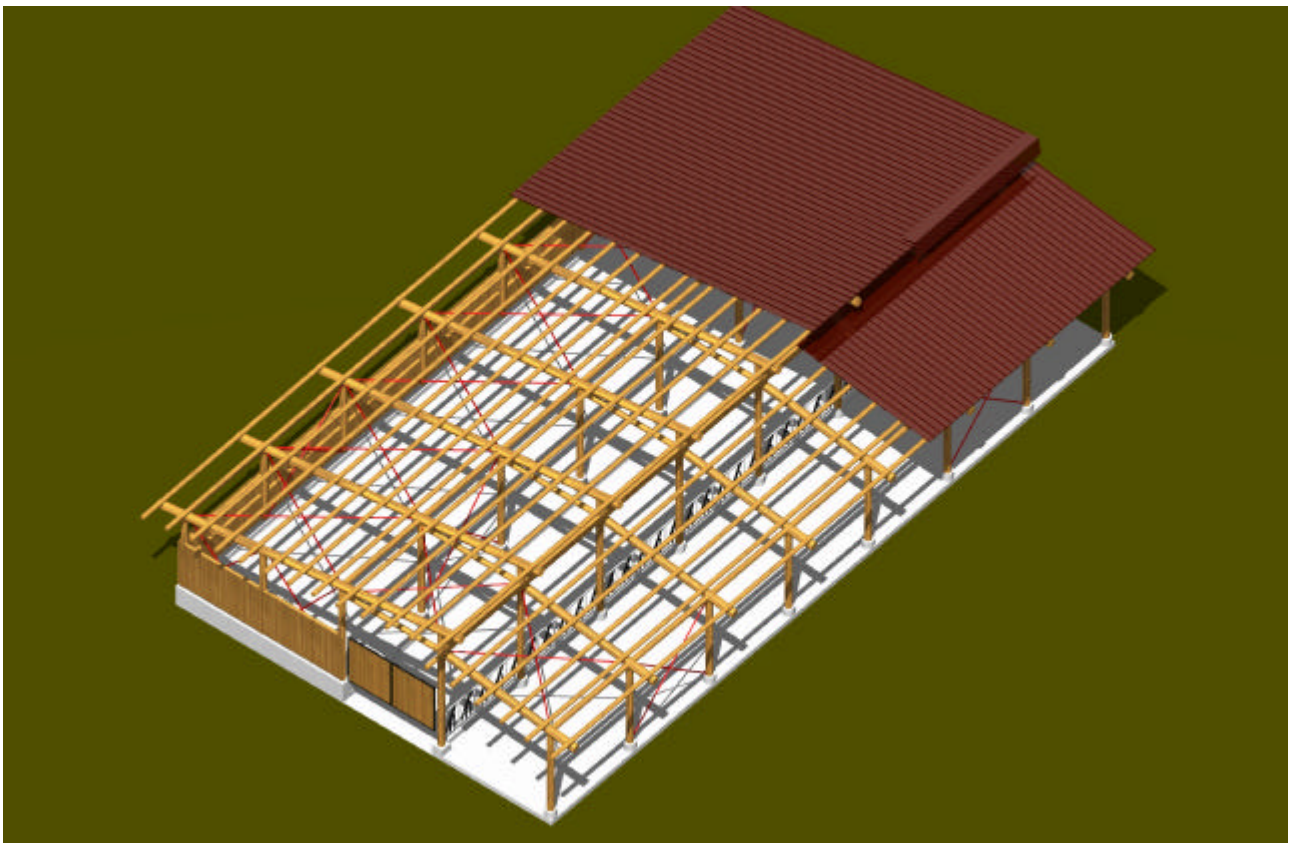


Fig. 11: The sloped floor loose housing: a 3-D representation.

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